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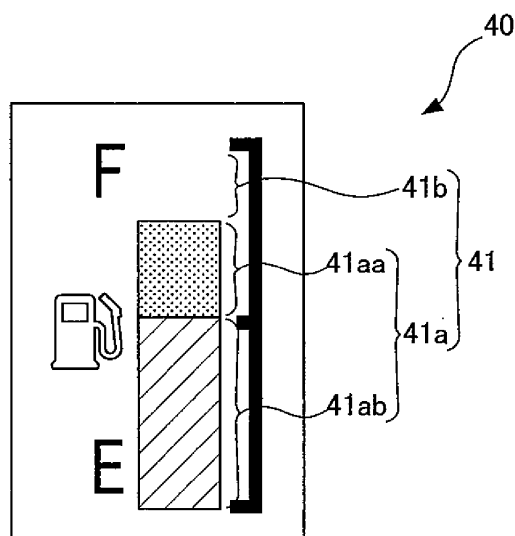
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(54) **HYBRID VEHICLE DISPLAY DEVICE**

(57) In the present invention, a display device is provided with a fuel gauge (40) that displays the amount of fuel remaining in a fuel tank (24) (remaining amount) of a hybrid vehicle (10) that is provided with an engine (13) that consumes fuel supplied from the fuel tank (24) and generates power by driving wheels (15) or rotating a motor (11), the hybrid vehicle being provided with a non-traveling/non-power generating mode, or in other words, a fuel consumption mode or an engine maintenance mode in which the engine (13) is forced to run and consume fuel for purposes other than traveling or generating power. Of the fuel (41a) displayed in the fuel gauge (40), the region (41aa) corresponding to the amount of fuel consumed in the non-traveling/non-power generating mode is displayed so as to be distinguishable by color from another region (41ab), and thus, it is possible to display as a status and in a visually clear manner a state in which the engine (13) continues to run, and it is possible for the driver to confirm how much fuel is being consumed in the non-traveling/non-power generating mode, thereby providing the driver with peace of mind.

Fig. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to a display device for a hybrid vehicle including an engine (internal combustion engine) and a motor (electric motor) as driving sources, which is particularly suitable for a plug-in hybrid vehicle the battery of which can be charged using an external commercial power source.

BACKGROUND ART

[0002] Conventionally, hybrid vehicles including an engine and motors have been developed, and in recent years, plug-in hybrid vehicles the battery of which can be charged using an external commercial power source have also been developed (Patent Document 1).

[0003] Some plug-in hybrid vehicles are configured to switch depending on the driving state between an EV mode in which the driving wheels are driven by only motors as power sources, a series mode in which the engine is used as an electric power supply source (electric generator) for the motors while the motors are used as power sources, and a parallel mode in which both the engine and the motors are used as power sources. This enables a significant reduction in fuel consumption.

[0004] Meanwhile, if the fuel to be used for the engine remains in the fuel tank or pipes for a long period of time, the fuel changes in quality and deteriorates due to oxidation, dissolution of water, and the like. For example, volatile components of the fuel evaporate, and the ratio of the fuel components sometimes becomes unsuitable. Such change and deterioration of the fuel may cause rusting in the fuel tank, or a problem that the engine will not exhibit sufficient performance when running.

[0005] In other words, hybrid vehicles have the advantage that the fuel consumption can be reduced compared to gasoline vehicles, but at the same time have the problem that it is likely the fuel remains in the fuel tank for a long period of time and causes the problems described above.

[0006] In particular, plug-in hybrid vehicles are capable of performing electric travelling for a long time by externally charging the battery, without consuming the fuel in the fuel tank for a long time. Hence, depending on the usage by the user, plug-in hybrid vehicles are used in the EV mode, in other words, used as an electric vehicle for everyday use, which makes the problems by the fuel deterioration more likely to occur.

[0007] In addition, while an engine is left unused for a long time, oil (oil film) attached to the cylinders and other parts falls off due to gravity and vibration during travelling, which decreases the protection performance against friction between metal parts. If the engine is started repeatedly without enough oil film (dry start), there is a risk of damage such as frictional wear or burning out of parts inside the engine. Moreover, leaving the engine unused

for a long time sometimes causes sticking inside an injector (fuel injection device) and air entrainment in a fuel pipe, which prevent a smooth start of the engine.

[0008] In summary, while hybrid vehicles have the advantage of less fuel consumption than gasoline vehicles, there is a problem that if the engine is left unused for a long time, the problems described above are likely to occur.

[0009] In particular, plug-in hybrid vehicles are capable of performing electric travelling for a long time by externally charging the battery, without consuming the fuel in the fuel tank for a long time. Hence, depending on the usage by the user, plug-in hybrid vehicles are used in the EV mode, in other words, used as an electric vehicle for everyday use. As a result, plug-in hybrid vehicles are likely to fall into the case described above, which makes the problems caused by leaving the engine unused for a long time more likely to occur.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0010] Patent Document 1: Japanese Patent Application Publication No. 2012-30668

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0011] To solve the problems on the fuel deterioration described above, typical plug-in hybrid vehicles have a "fuel consumption mode" in which the engine is forced to run to consume fuel in the case where a specified amount of refueling has not been done for a specified period. After performing the fuel consumption mode, the vehicle prompts a specified amount or more of refueling to keep the freshness of the fuel in the fuel tank. In this way, in the fuel consumption mode, the engine is forced to run to prevent the deterioration and change in quality of the fuel remaining in the fuel tank. However, the amount of fuel to be consumed in the fuel consumption mode, in other words, the required consumption amount is not conventionally displayed to the driver.

[0012] For this reason, the driver sometimes feels anxious because the driver cannot see how the fuel is consumed in the fuel consumption mode.

[0013] Meanwhile, to solve the problems caused by leaving an engine unused for a long time described above, typical plug-in hybrid vehicles have an "engine maintenance mode" in which the engine is forced to run in the case where operation of the engine (= fuel consumption = opportunity of refueling) does not take place for a specified period of time. By performing the engine maintenance mode, appropriate functions in the engine are maintained.

[0014] In this way, in the engine maintenance mode, the engine is forced to run to maintain appropriate func-

tions in the engine. However, the amount of fuel to be consumed in the engine maintenance mode, in other words, the required consumption amount is not conventionally displayed to the driver.

[0015] For this reason, the driver sometimes feels anxious because the driver cannot see how the fuel is consumed in the engine maintenance mode.

[0016] The present invention has been made in view of the aforementioned conventional art, and an object of the present invention is to provide a display device that displays the required consumption amount, in other words, the status of the engine continuously running, in the fuel consumption mode or the engine maintenance mode.

[0017] Note that since the fuel consumption mode and the engine maintenance mode mean forcibly running the engine to consume fuel for purposes other than traveling and power generation, the fuel consumption mode and the engine maintenance mode are collectively called a non-traveling·non-power generating mode in the present invention. In other words, the non-traveling·non-power generating mode means the fuel consumption mode or the engine maintenance mode.

MEANS FOR SOLVING THE PROBLEMS

[0018] A display device for a hybrid vehicle according to claim 1 of the present invention to solve the aforesaid problems is a display device for a hybrid vehicle including: a motor that drives a wheel with electric power supplied from a battery; an engine that consumes fuel supplied from a fuel tank, and drives the wheel or generates electricity for the motor; and a non-traveling·non-power generating mode in which the engine is forced to run to consume the fuel for a purpose other than travelling and power generation, characterized in that the display device includes: a fuel gauge that displays the amount of the fuel remaining in the fuel tank; and a display device that displays a region corresponding to the amount of fuel to be consumed in the non-traveling·non-power generating mode, of the fuel displayed in the fuel gauge, such that the region is distinguishable by color from another region of the fuel.

[0019] A display device for a hybrid vehicle according to claim 2 of the present invention to solve the aforesaid problems is the display device for a hybrid vehicle according to claim 1 characterized in that an area of the region corresponding to the amount of the fuel to be consumed in the non-traveling·non-power generating mode decreases while the non-traveling·non-power generating mode is performed.

[0020] A display device for a hybrid vehicle according to claim 3 of the present invention to solve the aforesaid problems is the display device for a hybrid vehicle according to claim 1 characterized in that the battery is rechargeable using an external commercial power source.

[0021] A display device for a hybrid vehicle according to claim 4 of the present invention to solve the aforesaid

problems is the display device for a hybrid vehicle according to claim 1 characterized in that the non-traveling·non-power generating mode is a fuel consumption mode for preventing deterioration and change in quality of the fuel remaining in the fuel tank.

[0022] A display device for a hybrid vehicle according to claim 5 of the present invention to solve the aforesaid problems is the display device for a hybrid vehicle according to claim 1 characterized in that the non-traveling·non-power generating mode is an engine maintenance mode for maintaining an appropriate functioning of the engine.

EFFECT OF THE INVENTION

[0023] The display device for a hybrid vehicle according to the present invention is provided with the fuel gauge capable of displaying the region corresponding to the amount of fuel to be consumed in the non-traveling·non-power generating mode for purposes other than traveling and power generation such that the region is distinguishable by color from another region indicating the remaining fuel. As a result, the display device for a hybrid vehicle according to the present invention can display the state of the engine continuously running in the non-traveling·non-power generating mode, as a status visually and clearly, and makes it possible to obtain the advantageous effect which enables the driver to see how the fuel is being consumed in the non-traveling·non-power generating mode.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

[Fig. 1] Fig. 1 is a schematic diagram illustrating a hybrid vehicle.

[Fig. 2] Fig. 2 is a schematic diagram illustrating a display device for a hybrid vehicle.

[Fig. 3] Fig. 3 is a flowchart showing a fuel system maintenance mode of a hybrid vehicle according to a first embodiment of the present invention.

[Fig. 4] Fig. 4 is a flowchart showing an engine maintenance mode of a hybrid vehicle according to a second embodiment of the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0025] Hereinafter, descriptions will be provided for an embodiment of the present invention based on embodiments.

Embodiment 1

[0026] Figs. 1 to 3 illustrate a display device for a hybrid vehicle according to a first embodiment of the present invention.

[0027] This embodiment is one in which the present

invention is applied to a hybrid vehicle having a fuel consumption mode as a non-traveling non-power generating mode.

[0028] Specifically, as illustrated in Fig. 1, a hybrid vehicle (hereinafter also simply referred to as a "vehicle") 10 according to this embodiment is what is called a plug-in hybrid vehicle, and includes a front motor 11 and a rear motor 12, and an engine 13, as driving sources for travelling. The driving force of the front motor 11 is transmitted via a front drive transmission mechanism 14 to front wheels 15. The driving force of the rear motor 12 is transmitted via a rear drive transmission mechanism 16 to rear wheels 17.

[0029] A battery 19 is connected to the front motor 11 via a front (Fr) motor inverter 18, and the battery 19 is connected to the rear motor 12 via a rear (Re) motor inverter 20. The electric power corresponding to the pedal operation of the occupant is supplied from the battery 19 via these inverters 18 and 20 to the motors 11 and 12, respectively.

[0030] In addition, a sub-battery (12V battery) 22 for driving auxiliary machinery is connected to the battery 19 via a DC/DC converter 21. When the amount of charge in the sub-battery 22 lowers, the sub-battery 22 is charged by the battery 19. In addition, a vehicle mounted battery charger 23 is connected to the battery 19 so that the battery 19 can be charged also by an external commercial power source.

[0031] The engine 13 is driven by burning the fuel supplied from a fuel tank 24. A generator (electric generator) 26 is connected to the engine 13 via an output system 25. The generator 26 is connected via a generator inverter 27 to the battery 19 (and the front motor 11). The output system 25 is connected to the generator 26 on one hand, and to the front drive transmission mechanism 14 via a clutch 28 on the other hand.

[0032] When the engine 13 is driven in accordance with the driving state of the vehicle 10, the driving force of the engine 13 is first transmitted via the output system 25 to the generator 26. The generator 26 operates with the driving force of the engine 13, and the electric power generated by the generator 26 is supplied to the front motor 11 and the battery 19 as appropriate. When the clutch 28 is engaged in accordance with the driving state of the vehicle 10, the driving force of the engine 13 is also transmitted via the front drive transmission mechanism 14 to the front wheels 15.

[0033] Further, the vehicle 10 is provided with a control device (ECU) 30 that comprehensively controls various devices mounted on the vehicle 10. The control device 30 grasps the driving state of the vehicle 10 based on signals from various sensors provided in the vehicle 10 and comprehensively controls the various devices based on the driving state. Specifically, the traveling mode is also selected by this control device 30 depending on the driving state of the vehicle 10.

[0034] In addition, the control device 30 has a "fuel consumption mode" in which in the case where a spec-

ified amount of refueling has not been done for a specified period, the engine 13 is forced to run to prevent the deterioration and change in quality of the fuel remaining in the fuel tank 24. An example is the case where the engine has sat unused with the fuel tank full for six months and 15 liters or more of refueling has not been done during the period.

[0035] Further in this embodiment, the vehicle 10 includes a fuel gauge 40 illustrated in Fig. 2 as a display device. In this fuel gauge 40, an English letter E (empty) is arranged at a lower part, and an F (full) at an upper part, and a mark of the fuel dispenser as a symbol is arranged at a middle part. At a side of these, a rectangular display portion (scale) 41 is arranged extending continuously in an up and down direction.

[0036] The display portion 41 includes a remaining amount portion 41a indicating the amount corresponding to the fuel currently remaining in the fuel tank 24 (remaining amount) and a vacant space portion 41b indicating the amount corresponding to the vacant space of the fuel tank 24 which can be currently refueled. The vacant space portion 41b has the same color as the background color.

[0037] The remaining amount displayed at the remaining amount portion 41a is calculated by the control device 30 based on the height measured by a fuel level sensor (illustration thereof omitted) provided to the fuel tank 24.

[0038] The remaining amount portion 41a includes a remaining amount upper portion (shown stippled in the figure) 41aa displaying the amount corresponding to a required consumption amount in the fuel consumption mode and a remaining amount lower portion (shown hatched in the figure) 41ab displaying the amount corresponding to the value obtained by subtracting the required consumption amount in the fuel consumption mode from the amount of the fuel remaining in the fuel tank. For example, the remaining amount upper portion 41aa is displayed in an orange color, and the remaining amount lower portion 41ab in a blue color.

[0039] The required consumption amount in the fuel consumption mode displayed by the remaining amount upper portion 41aa, that is, the amount of fuel to be consumed to prevent the deterioration and change in quality of the fuel remaining in the fuel tank 24 may be determined in advance as a constant amount (for example, one third of the fuel tank \approx 15 liters). Alternatively, the required consumption amount may be obtained by calculation of the control device 30 based on the period for which there has been no refueling.

[0040] Note that the remaining amount upper portion 41aa is displayed such that the area thereof decreases gradually in accordance with the consumption of the fuel while the fuel consumption mode is performed. The color of the portion corresponding to the consumed fuel is changed to the background color.

[0041] Here, Fig. 2 shows a display in the fuel system maintenance mode as described later, which is capable of displaying the status on how much the required con-

sumption amount in the fuel consumption mode is visually and clearly because the remaining amount upper portion 41aa and the remaining amount lower portion 41ab have different colors in the fuel system maintenance mode. Note that except when in the fuel system maintenance mode, the remaining amount upper portion 41aa has the same color as the remaining amount lower portion 41ab. As described in Fig. 3, the fuel system maintenance mode includes the fuel consumption mode.

[0042] Note that Fig. 2 shows an example of the fuel gauge 40, and various modifications can be made thereto. For example, the display portion 41 may be a digital display portion in which multiple segments having different colors are stacked, or an analog meter display using needles having different colors, and also the shape may be not only rectangular but of a semicircular arc shape. In any way, of the remaining amount, the region corresponding to the fuel amount to be consumed in the fuel consumption mode only needs to be displayed to be distinguishable by color from the other region of the remaining amount.

[0043] In addition, in the fuel system maintenance mode described later, a display indicating the fuel system maintenance mode, a warning indicating that the engine is forced to run to consume a specified amount of fuel, and a warning to prompt a specified amount of refueling may be added in the fuel gauge 40. Or alternatively, these indications may be displayed at other positions to attract extra attention of the driver.

[0044] Further, in the fuel gauge 40, a display portion numerically indicating the required consumption amount in the fuel consumption mode/the fuel amount already consumed in the fuel consumption mode may be added. In addition, a display portion may be added to show a bar graph or a numerical value indicating the time needed to perform the fuel consumption mode/the elapsed time. Such times are also obtained by calculation of the control device 30.

[0045] Descriptions will be provided for the display of the fuel gauge 40 when the fuel consumption mode according to this embodiment is performed, referring to a flowchart shown in Fig. 3. Specifically, Fig. 3 shows the fuel system maintenance mode for displaying the required consumption amount in the fuel consumption mode in which the engine is caused to run to forcibly consume fuel, that is, the status of the engine continuously running.

[0046] First, the control device 30 starts the fuel system maintenance mode (step S1), displays to the effect, and then determines whether or not the fuel tank 24 has a vacant space which can be refilled with a specified amount of fuel (step S2). The specified amount may be, for example, 15 liters.

[0047] Next, if NO at step S2, in other words, if the fuel tank 24 does not have a vacant space that can be refilled with the specified amount of fuel, the control device 30 starts the fuel consumption mode in which the engine 13 is forced to run (step S3).

[0048] In the fuel consumption mode, as illustrated in Fig. 2, a warning is displayed indicating the engine is forced to run to consume the specified amount of fuel. At the same time, a part of the fuel display corresponding to the amount of fuel necessary to be consumed in the fuel consumption mode is changed in color. In other words, in the remaining amount portion 41a, the remaining amount upper portion 41aa and the remaining amount lower portion 41ab are differentiated by color. Then, the remaining amount upper portion 41aa is displayed such that the area thereof decreases gradually in accordance with the consumption of fuel while the fuel consumption mode is performed (step S4).

[0049] As the warning indicating that the engine is forced to run, for example, a message, "Fuel system maintenance. Engine will run to consume fuel." is displayed.

[0050] Subsequently, the control device 30 determines whether the specified amount of fuel has been consumed (step S5). If NO, step S4 is repeated. On the other hand, if YES, in other words, if the required consumption amount in the fuel consumption mode has been consumed, the fuel consumption mode ends (step S6). When the fuel consumption mode ends, the control device 30 stops the engine 13.

[0051] After the fuel consumption mode ends at step S6 and if YES at step S2, in other words, when the fuel tank 24 has a vacant space which can be refilled with the specified amount of fuel, a warning to prompt the specified amount of refueling is displayed (step S7). As the warning to prompt the specified amount of refueling, for example, a message, "Fuel system maintenance. Refill the fuel tank 24 with 15 liters or more of fuel at a time." is displayed.

[0052] After displaying the warning at step S7, the control device 30 determines whether or not the specified amount or more of fuel is supplied to the fuel tank 24 (step S8). If NO, step S7 is repeated. On the other hand, if YES, in other words, if the specified amount or more of fuel has been supplied to the fuel tank, the control device 30 turns off the display indicating the fuel system maintenance and other warnings, and finishes the fuel system maintenance mode (step S9).

[0053] As specifically described above based on the embodiment, as for the display device for the hybrid vehicle 10 including the fuel consumption mode in which the engine 13 is forced to run to prevent deterioration and change in quality of the fuel remaining in the fuel tank 24, the color of the remaining amount upper portion 41aa of the remaining amount portion 41a displayed on the fuel gauge 40, corresponding to the amount of fuel to be consumed in the fuel consumption mode, is changed to be different from the color of the other portion, which is the remaining amount lower portion 41ab. In addition, the remaining amount upper portion 41aa is displayed such that the area thereof decreases gradually in accordance with the fuel consumption while the fuel consumption mode is performed. Hence the state of the en-

engine 13 continuously running can be displayed as a status visually and clearly, which makes it possible to obtain the advantageous effect that enables the driver to see how the fuel is being consumed in the fuel consumption mode, and makes the driver free from anxiety.

Embodiment 2

[0054] A display device for a hybrid vehicle according to a second embodiment of the present invention is described in Figs. 1, 2, and 4.

[0055] This embodiment is one in which the present invention is applied to a hybrid vehicle including an engine maintenance mode as a non-traveling-non-power generating mode.

[0056] For this reason, a schematic diagram of the hybrid vehicle and a display device for a hybrid vehicle in this embodiment are as illustrated in Figs. 1 and 2 as in the first embodiment. A feature of the embodiment is performing an engine maintenance mode shown in Fig. 4 instead of the fuel consumption mode shown in Fig. 3.

[0057] Specifically, as illustrated in Fig. 1, a hybrid vehicle 10 according to this embodiment is the same as in the first embodiment in that the hybrid vehicle 10 includes : a front motor 11 and a rear motor 12; an engine 13; a front drive transmission mechanism 14 and front wheels 15; a rear drive transmission mechanism 16 and rear wheels 17; a front (Fr) motor inverter 18 and a battery 19; a rear (Re) motor inverter 20; a DC/DC converter 21; a sub-battery (12V battery) 22; a vehicle mounted battery charger 23; a fuel tank 24; an output system 25, a generator (electric generator) 26, and a generator inverter 27; and a clutch 28.

[0058] In addition, this embodiment is the same as the first embodiment also in that the vehicle 10 is provided with a control device (ECU) 30 that comprehensively controls various devices mounted on the vehicle 10.

[0059] In particular, the control device 30 is characterized by including an "engine maintenance mode" instead of the "fuel consumption mode" in the first embodiment, in which in the case operation of the engine (= fuel consumption = opportunity of refueling) does not take place for a certain period of time, the engine 13 is forced to run to maintain appropriate functions in the engine. Note that this embodiment is the same as the first embodiment in that the control device 30 in this embodiment also has a non-traveling-non-power generating mode because the engine maintenance mode is a "non-traveling-non-power generating mode" the same as the fuel consumption mode is.

[0060] In addition, this embodiment is also the same as the first embodiment in that a fuel gauge 40 illustrated in Fig. 2 is included as a display device in the vehicle 10.

[0061] This fuel gauge 40 is the same as in the first embodiment in that the fuel gauge 40 includes a rectangular display portion (scale) 41 extending continuously in an up and down direction and the display portion 41 includes a remaining amount portion 41a indicating the

amount corresponding to the fuel currently remaining in the fuel tank 24 (remaining amount) and a vacant space portion 41b indicating the amount corresponding to the vacant space of the fuel tank 24 which can be currently refueled.

[0062] In particular, the remaining amount portion 41a is characterized by including a remaining amount upper portion (shown stippled in the figure) 41aa and a remaining amount lower portion (shown hatched in the figure) 41ab, the remaining amount upper portion 41aa indicating the amount corresponding to the required consumption amount in the engine maintenance mode instead of the fuel consumption mode. In the same way, the remaining amount lower portion 41ab is characterized by indicating the amount corresponding to the value obtained by subtracting the required consumption amount in the engine maintenance mode, instead of in the fuel consumption mode, from the amount of the fuel remaining in the fuel tank. For example, the remaining amount upper portion 41aa may be displayed in an orange color, and the remaining amount lower portion 41ab in a blue color.

[0063] The required consumption amount in the engine maintenance mode, indicated by the remaining amount upper portion 41aa, in other words, the amount of fuel consumed to maintain appropriate functions in the engine may be determined in advance as a constant amount (for example, 2 to 5 liters). Note that the required consumption amount may be obtained by calculation of the control device 30 based on the period for which there has been no refueling.

[0064] Further, the remaining amount upper portion 41aa is displayed such that the area thereof decreases in accordance with the fuel consumption while the engine maintenance mode is performed. The color of the portion corresponding to the consumed fuel is changed to the background color.

[0065] Here, Fig. 2 shows a display in the engine maintenance mode as described later. In the engine maintenance mode, the colors of the remaining amount upper portion 41aa and the remaining amount lower portion 41ab are different from each other, which makes it possible to display visually and clearly a status on how much the required consumption amount in the engine maintenance mode is. Note that except when in the engine maintenance mode, the color of the remaining amount upper portion 41aa is the same as that of the remaining amount lower portion 41ab.

[0066] Note that Fig. 2 shows an example of the fuel gauge 40, and various modifications can be made thereto. For example, the display portion 41 may be a digital display portion in which multiple segments having different colors are stacked, or an analog meter display using needles having different colors, and also the shape may be not only rectangular but of a semicircular arc shape. This embodiment is the same as the first embodiment also in that, in any way, of the remaining amount, the region corresponding to the fuel amount to be consumed in the engine maintenance mode only needs to be dis-

played to be distinguishable by color from the other region of the remaining amount.

[0067] In addition, in the engine maintenance mode described later, a warning indicating the engine is forced to run to consume a specified amount of fuel and a warning to prompt a specified amount or more of refueling before the engine maintenance mode is started may be added in the fuel gauge 40. Or alternatively, these indications may be displayed at other positions to attract extra attention of the driver.

[0068] Further, in the fuel gauge 40, a display portion numerically indicating the required consumption amount in the engine maintenance mode/the fuel amount already consumed in the engine maintenance mode may be added. In addition, a display portion may be added to show a bar graph or a numerical value indicating the time needed to perform the engine maintenance mode/the elapsed time. Such times are also obtained by calculation of the control device 30.

[0069] Descriptions will be provided for the display of the fuel gauge 40 when the engine maintenance mode according to this embodiment is performed, referring to a flowchart shown in Fig. 4. Specifically, Fig. 4 shows the engine maintenance mode for displaying the required consumption amount in the engine maintenance mode in which the engine is caused to run to forcibly consume fuel, that is, the status of the engine continuously running.

[0070] First, the control device 30 determines whether or not the engine has run continuously for a specified time within a specified period (step T1). This is because in order to maintain appropriate functions in the engine, circulation of oil in the engine is necessary, which requires a certain time of continuous operation.

[0071] If YES at step T1, the procedure ends without starting the engine maintenance mode. On the other hand, if NO, in other words, in the case where the engine has not run continuously for the specified time within the specified period, the control device 30 determines whether or not a specified amount of fuel remains in the fuel tank 24 (step T2). This is because without the specified amount of fuel in the fuel tank 24, the engine cannot be forced to run.

[0072] Next, if NO at step T2, a warning to prompt a specified amount or more of refueling is displayed (step T3). As the warning to prompt a specified amount or more of refueling, for example, a message, "Lack of fuel needed for engine maintenance. Please refuel." is displayed.

[0073] On the other hand, if YES at step T2, in other words, in the case where a specified amount of fuel remains in the fuel tank 24, the control device 30 starts the engine maintenance mode in which the engine 13 is forced to run (step T4).

[0074] In the engine maintenance mode, as illustrated in Fig. 2, a warning is displayed indicating the engine is forced to run to consume the specified amount of fuel. At the same time, a part of the fuel display corresponding to the amount of fuel necessary to consume in the engine maintenance mode is changed in color. In other words,

in the remaining amount portion 41a, the remaining amount upper portion 41aa and the remaining amount lower portion 41ab are differentiated by color. Then, the remaining amount upper portion 41aa is displayed such that the area thereof decreases gradually in accordance with the consumption of fuel while the engine maintenance mode is performed (step T5).

[0075] As the warning indicating that the engine is forced to run, for example, a message, "For engine maintenance, engine will run to consume fuel." is displayed.

[0076] Subsequently, the control device 30 determines whether the specified amount of fuel has been consumed (step T6). If NO, step S5 is repeated. On the other hand, if YES, in other words, if the required consumption amount in the engine maintenance mode has been consumed, the engine maintenance mode ends (step T7). When the engine maintenance mode ends, the control device 30 stops the engine 13 and turns off the warning.

[0077] As specifically described above based on the embodiment, as for the display device for the hybrid vehicle 10 including the engine maintenance mode in which the engine is forced to run to maintain appropriate functions in the engine 13, the color of the remaining amount upper portion 41aa of the remaining amount portion 41a displayed on the fuel gauge 40, corresponding to the amount of fuel to be consumed in the engine maintenance mode, is changed to be different from the color of the other portion, which is the remaining amount lower portion 41ab. In addition, the remaining amount upper portion 41aa is displayed such that the area thereof decreases gradually in accordance with the fuel consumption while the engine maintenance mode is performed. Hence the state of the engine 13 continuously running can be displayed as a status visually and clearly, which makes it possible to obtain the advantageous effect that enables the driver to see how the fuel is being consumed in the engine maintenance mode and makes the driver free from anxiety.

INDUSTRIAL APPLICABILITY

[0078] The present invention is industrially widely applicable as a display device for a hybrid vehicle, particularly, as a display device for a plug-in hybrid vehicle, including the non-traveling·non-power generating mode.

REFERENCE SIGNS LIST

[0079]

10	vehicle (hybrid vehicle)
11	front motor
12	rear motor
13	engine
14	front drive transmission mechanism
15	front wheel
16	rear drive transmission mechanism
17	rear wheel

18	front motor inverter		
19	battery		
20	rear motor inverter		
21	DC/DC converter		
22	sub-battery	5	
23	vehicle mounted battery charger		
24	fuel tank		
25	output system		
26	generator		
27	generator inverter	10	
28	clutch		
30	control device		
40	fuel gauge		
41	display portion		
41a	remaining amount portion	15	
41aa	remaining amount upper portion		
41ab	remaining amount lower portion		
41b	vacant space portion		

to claim 1, **characterized in that**
the non-traveling-non-power generating mode is a
fuel consumption mode for preventing deterioration
and change in quality of the fuel remaining in the fuel
tank.

5. The display device for a hybrid vehicle according to
claim 1, **characterized in that**
the non-traveling-non-power generating mode is an
engine maintenance mode for maintaining an appro-
priate functioning of the engine.

Claims

1. A display device for a hybrid vehicle including:

a motor that drives a wheel with electric power 25
supplied from a battery;
an engine that consumes fuel supplied from a
fuel tank, and drives the wheel or generates
electricity for the motor; and
a non-traveling-non-power generating mode in 30
which the engine is forced to run to consume
the fuel for a purpose other than travelling and
power generation, **characterized in that** the
display device comprises:

a fuel gauge that displays the amount of the 35
fuel remaining in the fuel tank; and
a display device that displays a region cor-
responding to the amount of fuel to be con-
sumed in the non-traveling-non-power gener- 40
ating mode, of the fuel displayed in the
fuel gauge, such that the region is distin-
guishable by color from another region of
the fuel.

2. The display device for a hybrid vehicle according to
claim 1, **characterized in that**
an area of the region corresponding to the amount
of the fuel to be consumed in the non-traveling-non- 50
power generating mode decreases while the non-
traveling-non-power generating mode is performed.
3. The display device for a hybrid vehicle according to
claim 1, **characterized in that**
the battery is rechargeable using an external com- 55
mercial power source.
4. J The display device for a hybrid vehicle according

Fig. 1

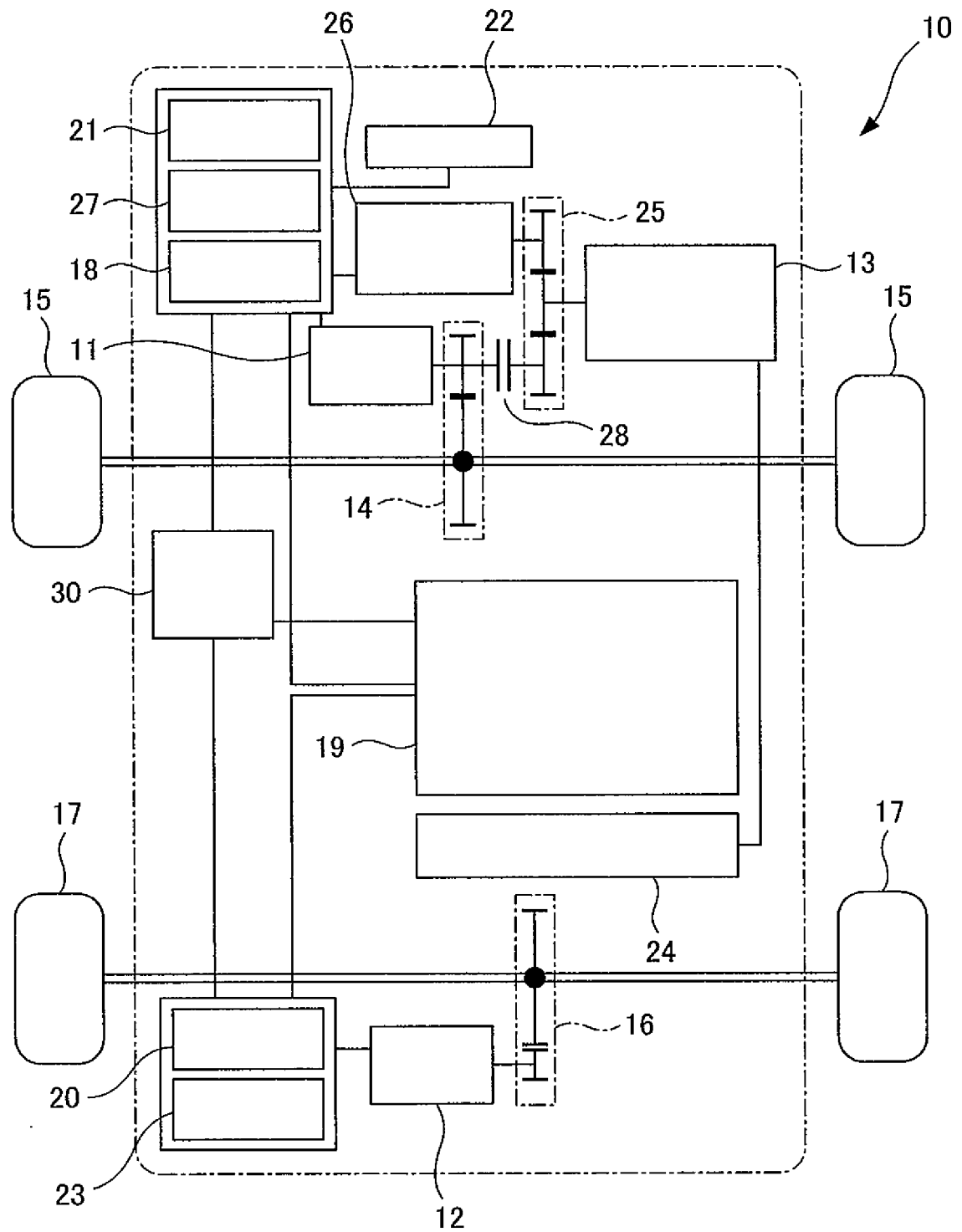


Fig. 2

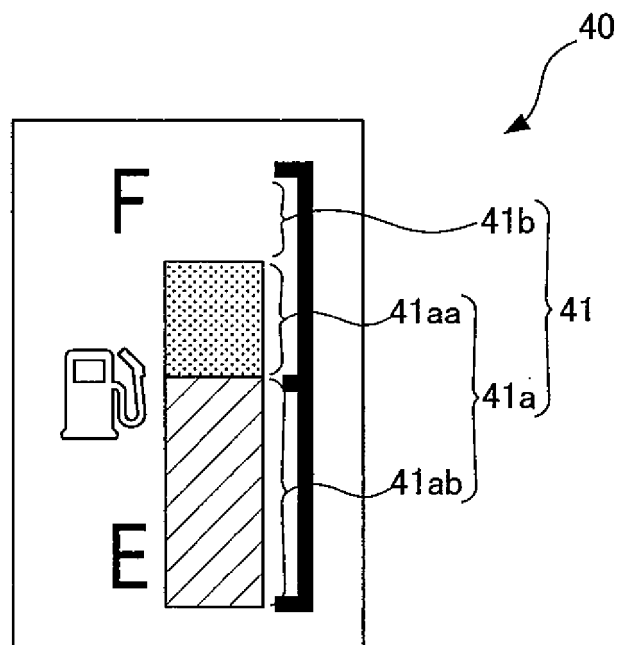


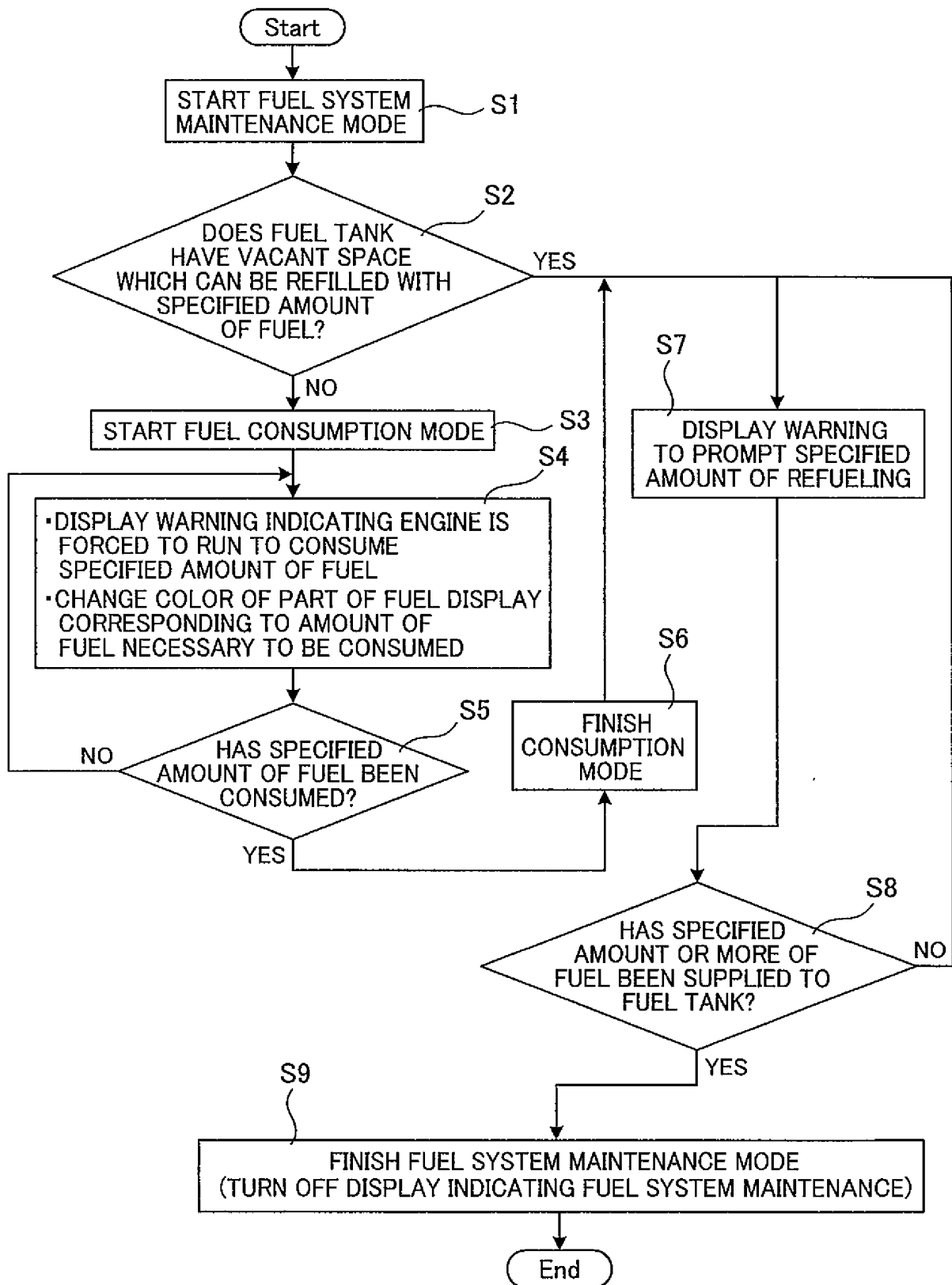
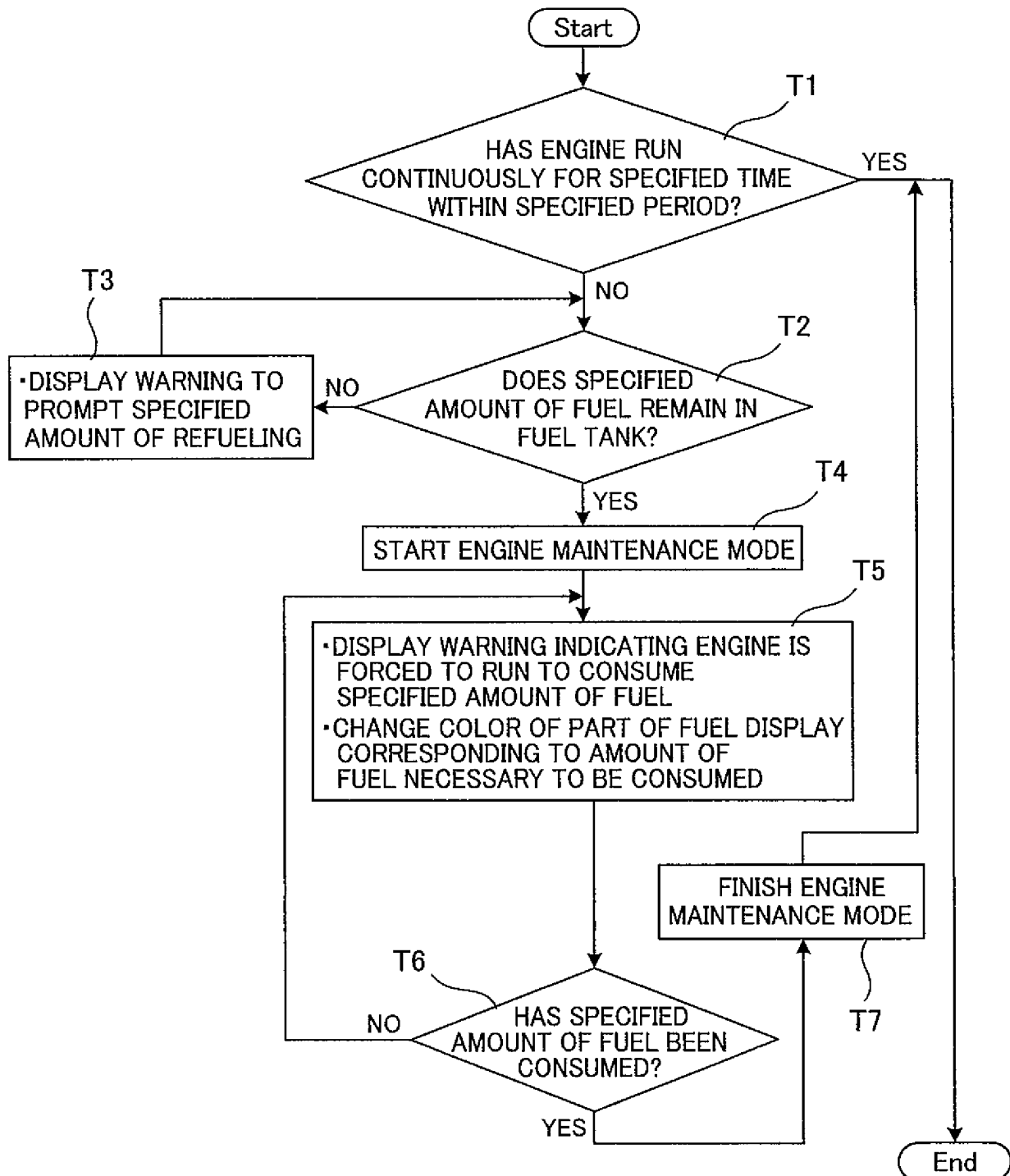
Fig. 3

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/079625

A. CLASSIFICATION OF SUBJECT MATTER

B60K6/22(2007.10)i, B60K6/44(2007.10)i, B60K6/52(2007.10)i, B60K35/00
(2006.01)i, B60R16/02(2006.01)i, B60W10/06(2006.01)i, B60W20/00(2016.01)i,
F02D45/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60K6/22, B60K6/44, B60K6/52, B60K35/00, B60R16/02, B60W10/06, B60W20/00,
F02D45/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2013-180739 A (Toyota Motor Corp.), 12 September 2013 (12.09.2013), paragraphs [0114] to [0115] (Family: none)	1-5
A	JP 2012-030667 A (Mitsubishi Motors Corp.), 16 February 2012 (16.02.2012), paragraphs [0003] to [0006], [0056] (Family: none)	1-5
A	JP 2003-217630 A (Nissan Motor Co., Ltd.), 31 July 2003 (31.07.2003), paragraphs [0190] to [0197]; fig. 30 (Family: none)	1-5



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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date and not in conflict with the application but cited to understand
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document of particular relevance; the claimed invention cannot be
considered novel or cannot be considered to involve an inventive
step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be
considered to involve an inventive step when the document is
combined with one or more other such documents, such combination
being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search
12 January 2016 (12.01.16)

Date of mailing of the international search report
26 January 2016 (26.01.16)

Name and mailing address of the ISA/
Japan Patent Office
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2012030668 A [0010]